

We might also have determined from the above equations the value of

$$\frac{dP}{dt},$$

and thence

$$\frac{dp}{dt},$$

and thus have found a relation between the variations of the major axis and the eccentricity. Thus our equations really determine the variations of three of the six elements of the orbit.

On the Variation of Latitude by the Greenwich Transit-Circle Observations. By S. C. Chandler.

The interesting communication of Messrs. Thackeray and Turner in the *Monthly Notices* for November 1892 was manifestly prepared before seeing the final law of the variation of latitude in No. 277 of the *Astronomical Journal*. I trust they will not deem it an encroachment on their province to point out that the general accordance of the observations with the provisional law of No. 267, which they have used, is still more satisfactory when the comparison is made with the definitive law. Without presuming to make a refined discussion, for which astronomers will look with interest to the continuation of the investigation by Messrs Thackeray and Turner, I find that the data of their Plate I. may be very satisfactorily represented by the expression

$$+ 0''.09 - 0''.141 \cos (t - 1885 \text{ Apr. } 23) \times 0^\circ 835 - 0''.148 \cos (\odot - 300^\circ) \quad (A)$$

The law on p. 100, *Astronomical Journal*, No. 277, gives

$$- 0''.120 \cos (t - 1885 \text{ Apr. } 9) \times 0^\circ 835 - 0''.110 \cos (\odot - 350^\circ).$$

The testimony of these observations is consequently entirely in harmony with the law in question, as will strikingly appear if the curve computed from equation (A) be entered upon Plate I. in the November *Monthly Notices*. Such a chart is given on Plate III.* The curve of equation (A) is represented by a dotted line; the observations by a zigzag continuous line, taking for the points of the latter the means of each successive three points, as given by Messrs. Thackeray and Turner, in order to eliminate, unobjectionably, the larger accidental errors.

These results tend still further to confirm the doubt expressed on p. 71, *Astronomical Journal*, No. 273, as to whether temperature-variation plays any significant part in the apparently anomalous results of this instrument, as has always been supposed. This matter has been the subject of a good deal of past investigation, but never with distinctly satisfactory conclusions; and in view of the new light which this freshly discovered annual

[* It was pointed out by Mr. Thackeray, but, unfortunately, not until after this plate had been printed off, that the theoretical curve is apparently one year in error. The portion for 1891 really belongs to 1890, and so on.—SECRETARIES.]

term in the variation of latitude will probably throw on it, the problem must be again examined, and exhaustively. It is hoped that Messrs. Thackeray and Turner will again cover the already well-travelled ground back to 1851.

I beg to add a remark on an important point. It might be maintained that the annual term in the latitude-variation is illusory, and merely the indication of a generally prevailing instrumental disturbance, due to temperature, and affecting all instruments and methods alike. This would be possible, but, in view of the actual facts, it is not at all probable. This explanation would require the maximum and minimum phases to occur in midwinter and midsummer, and at the same dates in all longitudes. This is not the case. The American observations, with the apparent exception of one series, place these phases three or four months earlier than the European; indicating a rotation from west to east for this annual term, the same as has already been proved, from the observations, for the 427-day term, independently of the theoretical considerations which require it to be so.

1892 December 26.

Latitude Variation and Greenwich Observations, 1851-91.

By W. Grasett Thackeray.

A preliminary paper on this subject was communicated to the Society in November last by Mr. Turner and myself. In it there was found to be indisputable evidence of the Chandler wave period, and grounds were shown for suspecting a five-yearly disturbance. This paper will be found to deal with—

1. The verification of the Chandler curve, as given in No. 277 of the *Astronomical Journal*;
2. The vindication of the correctness of the Greenwich Transit Circle Observations, more especially 1851-65.

1. The verification of the Chandler curve.

Since the publication of the first paper, the observations made at Honolulu and the allied observatories have added their testimony to the existence of a latitude variation, and Mr. Chandler in No. 277 of the *Astronomical Journal* has interpreted afresh the results of the laborious investigations he has undertaken on this subject. For a single term with a varying period he has substituted the resultant curve of two periodic fluctuations. The first of these two terms he has shown to have a period of 427 days and a semi-amplitude of about $0''.12$; the second an annual period depending on the Sun's longitude with a semi-amplitude ranging between $0''.04$ and $0''.20$ during the last half century. In the same paper are also given curves showing the theoretical value of the latitude from 1840-1894 and the twenty-days' groups of observations from 1840-1891 upon which the theory was founded.

This theoretical curve and the observations on which it depends have been compared with the Greenwich observations as